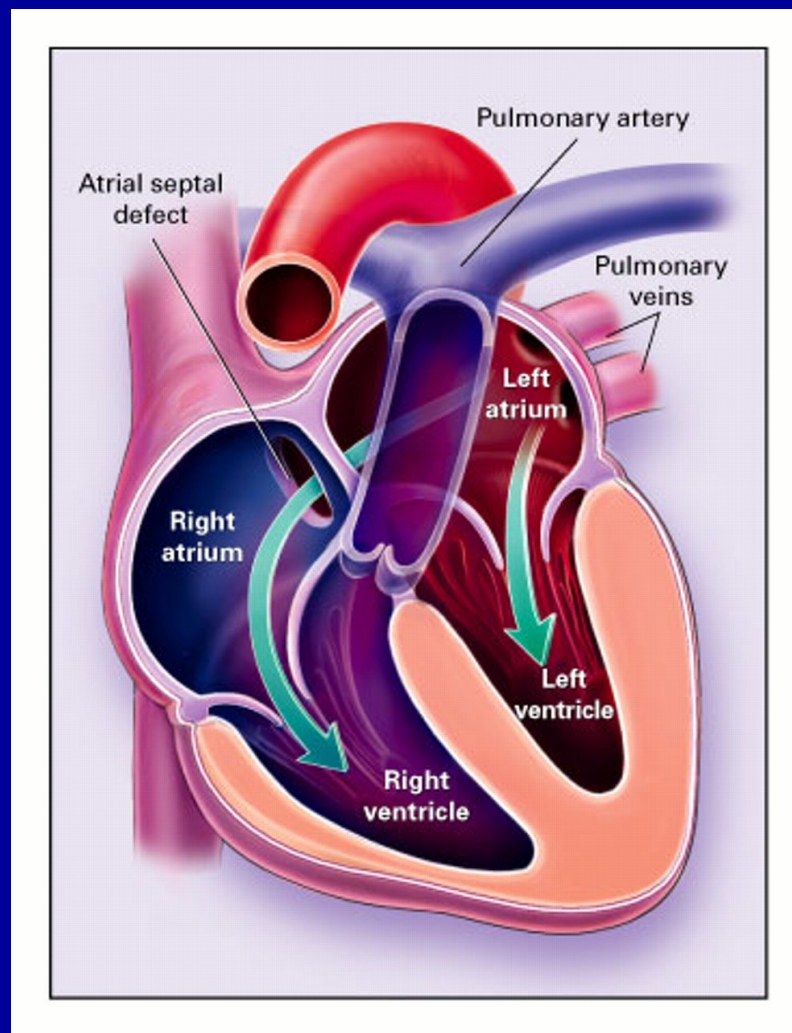


Cardiac Auscultation

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Atrial Septal Defect with Resultant Left-to-Right Shunting

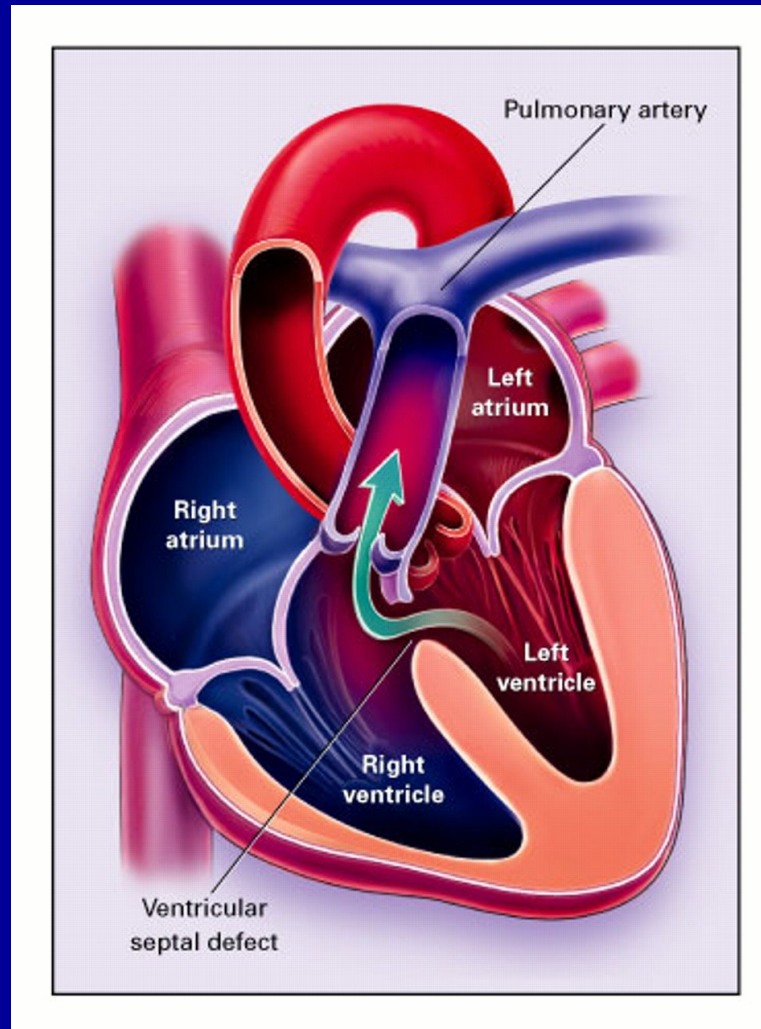


Brickner, M. E. et al. N Engl J Med 2000;342:256-263



The NEW ENGLAND
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Ventricular Septal Defect with Resultant Left-to-Right Shunting

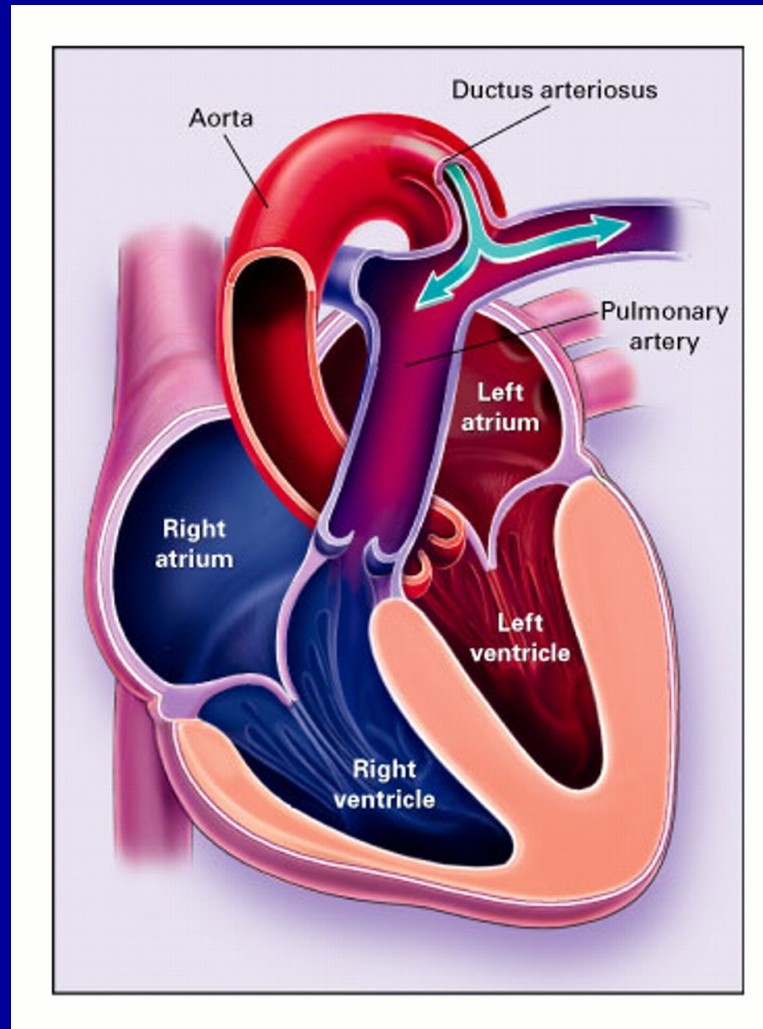


Brickner, M. E. et al. N Engl J Med 2000;342:256-263



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Patent Ductus Arteriosus with Resultant Left-to-Right Shunting

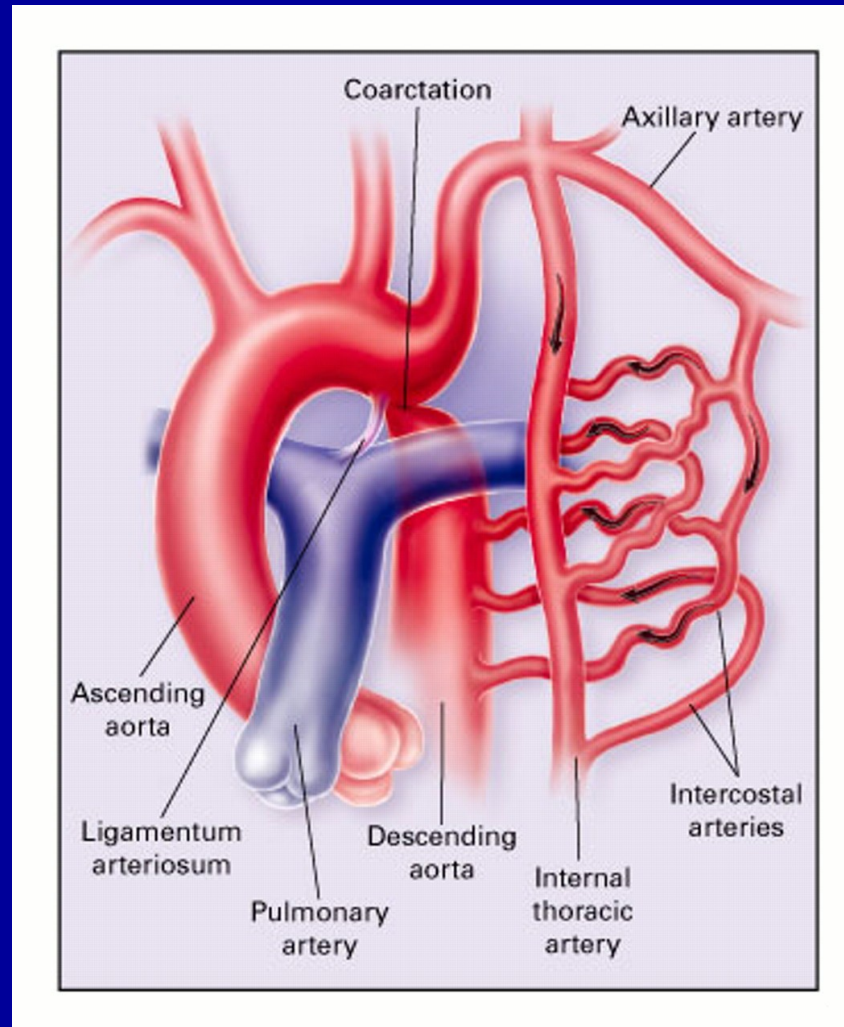


Brickner, M. E. et al. N Engl J Med 2000;342:256-263



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Coarctation of the Aorta

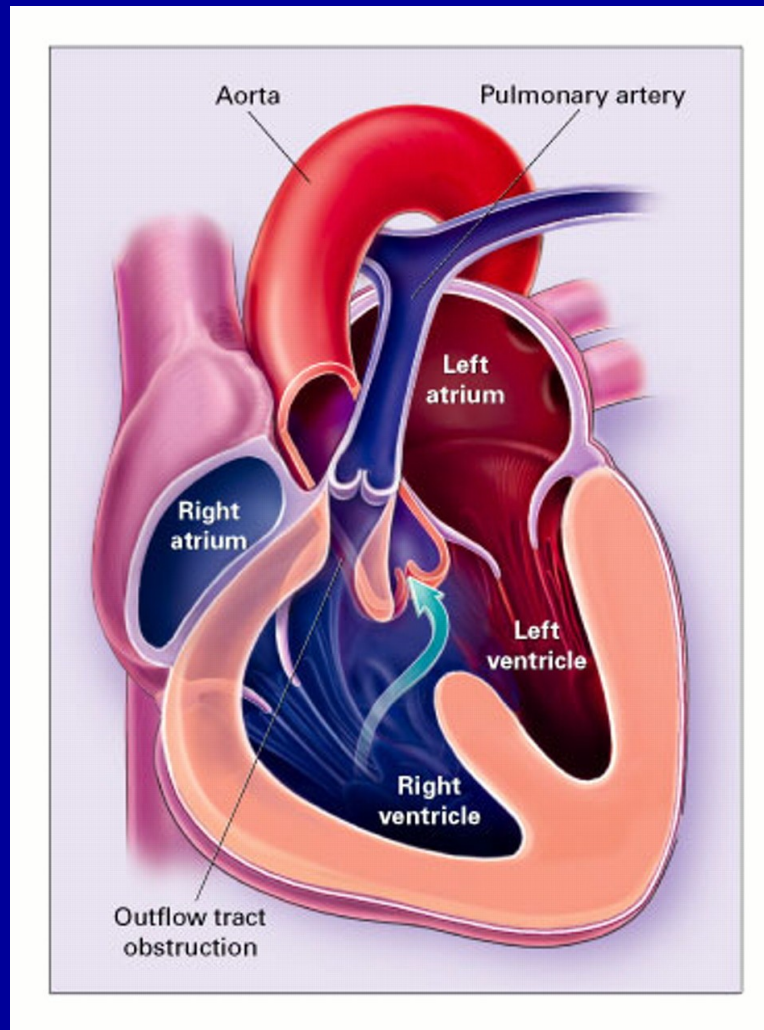


Brickner, M. E. et al. N Engl J Med 2000;342:256-263



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Tetralogy of Fallot

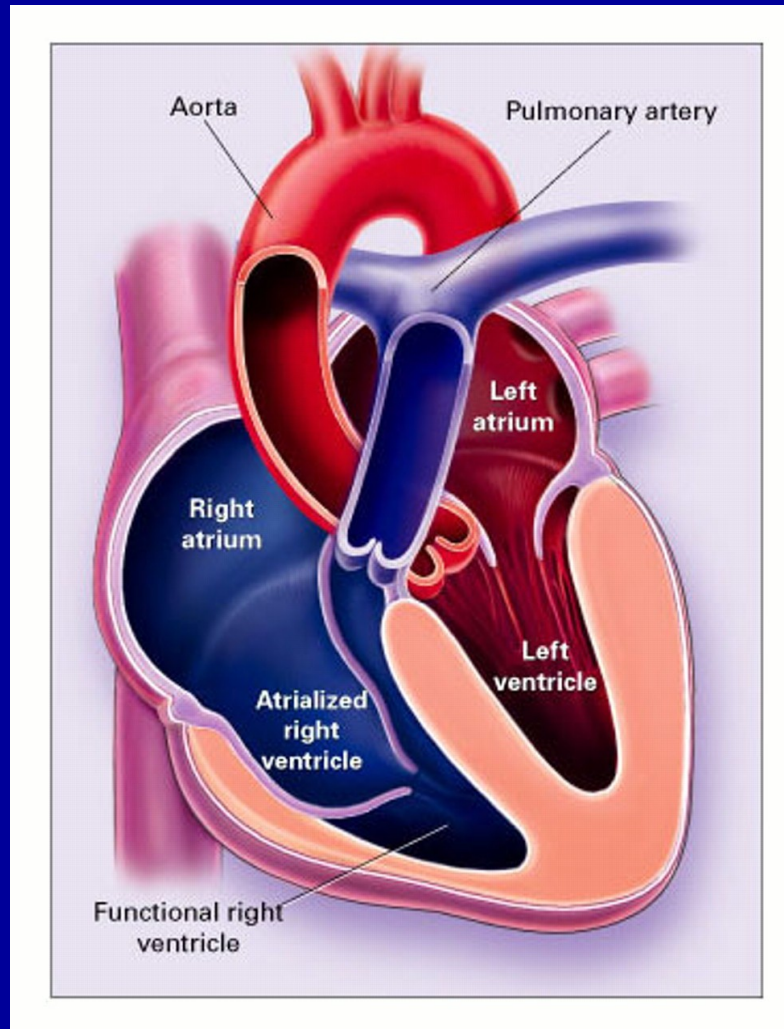


Brickner, M. E. et al. N Engl J Med 2000;342:334-342



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Ebstein's Anomaly

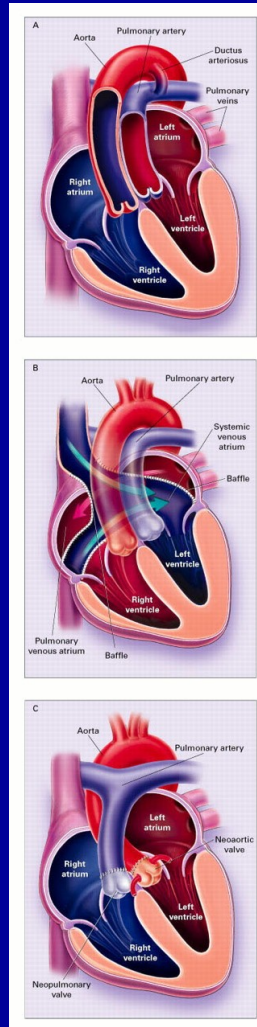


Brickner, M. E. et al. N Engl J Med 2000;342:334-342



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Transposition and Switching of the Great Arteries

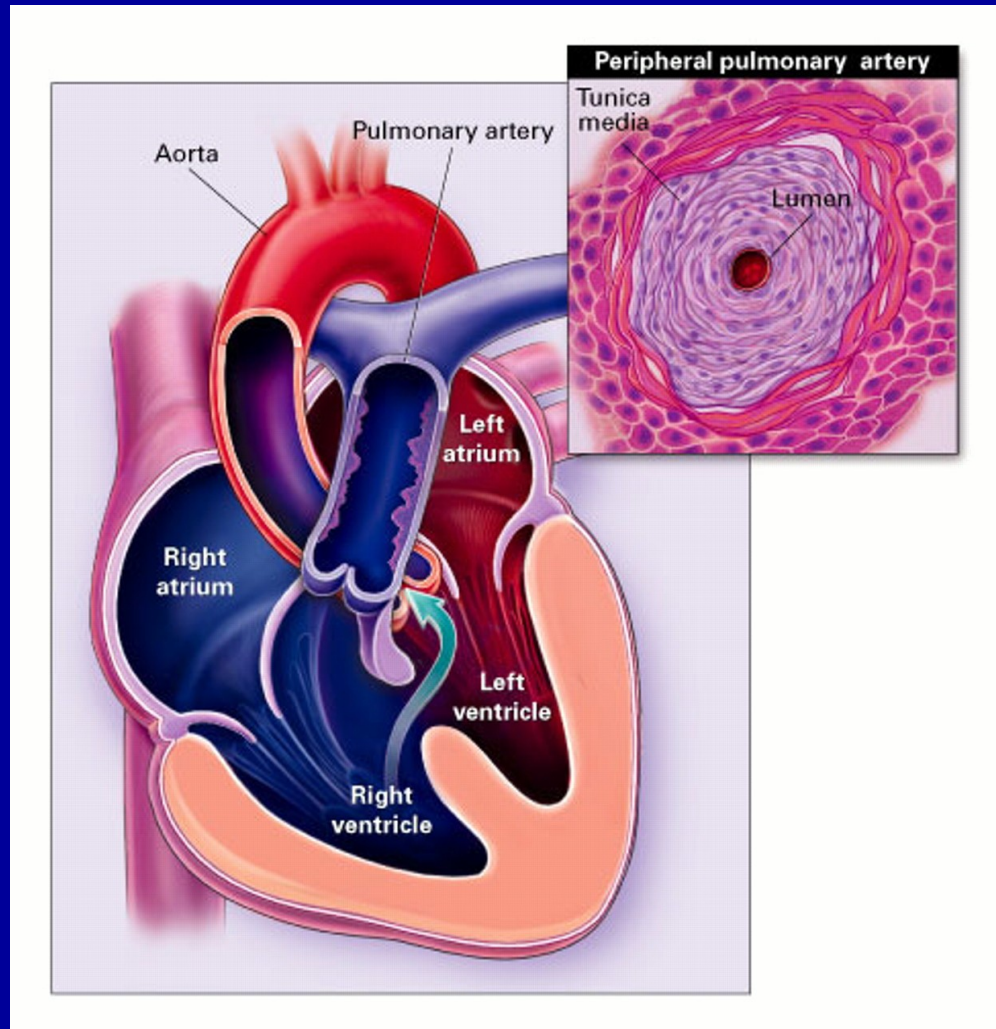


Brickner, M. E. et al. N Engl J Med 2000;342:334-342



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Eisenmenger's Syndrome



Brickner, M. E. et al. N Engl J Med 2000;342:334-342



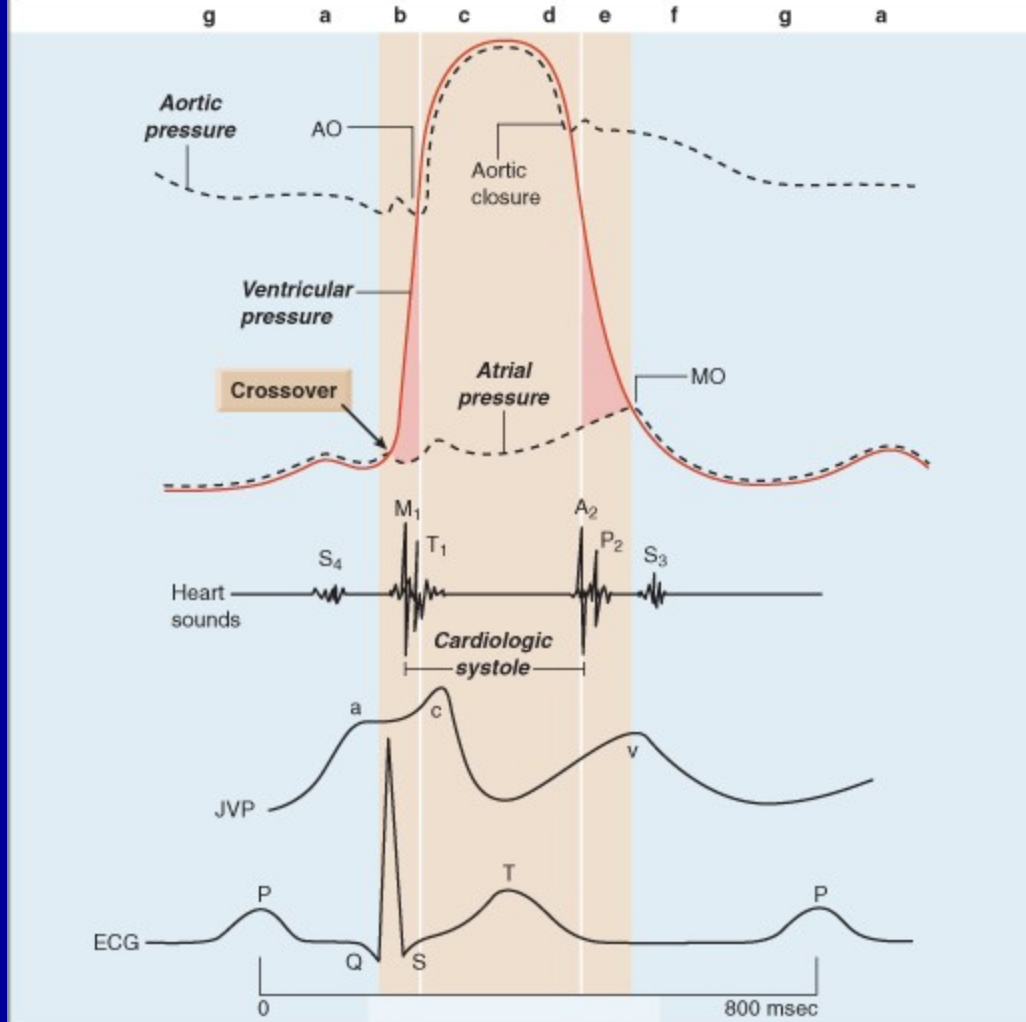
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Overview

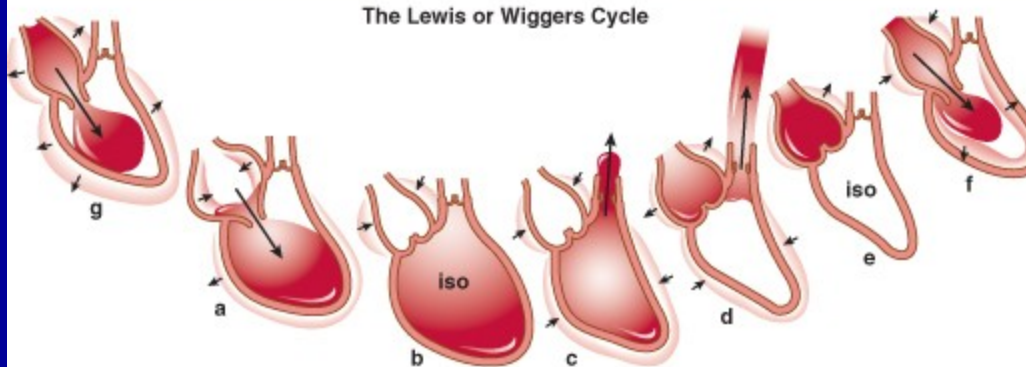
- Lecture
 - Normal and abnormal sounds
 - Mid-systolic murmurs

www.blaufuss.net/USUHS/tutorial/
 - Reminder
 - Clinical Concepts
 - discussion of cases/physical exam findings
- 11/30/06





The Lewis or Wiggers Cycle





First Heart Sound

- S1 generated by closure of AV valves
- Medium to high frequency
 - Heard all over precordium
 - Heard best with diaphragm in LLSB and apex
- Mitral valve closes before Tricuspid
 - Splitting of S1 audible in majority of subjects
 - *Don't be fooled into thinking a split S1 is an S4*



Intensity of S1

- Loud S1
 - Stiff valve
 - MITRAL STENOSIS
 - Rapid rise in LV pressure
 - Exercise, hyperdynamic state
 - Short PR interval
 - MV wide open when LV pressure starts rising



Intensity of S1

- Soft S1
 - Very stiff valve
 - Severe MITRAL STENOSIS
 - Decreased energy
 - Failing left ventricle
 - Long PR interval
 - MV has drifted closed and so doesn't move much with LV systole



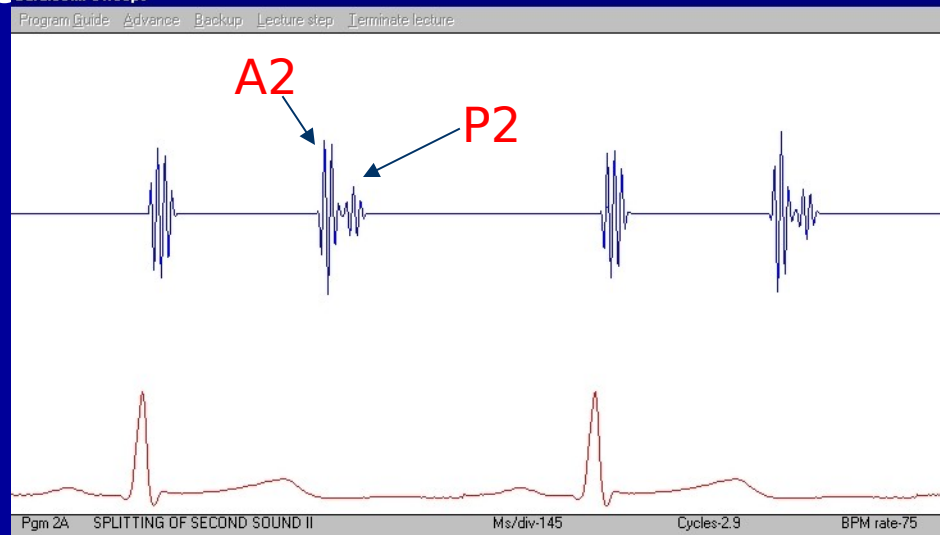
Second Heart Sound

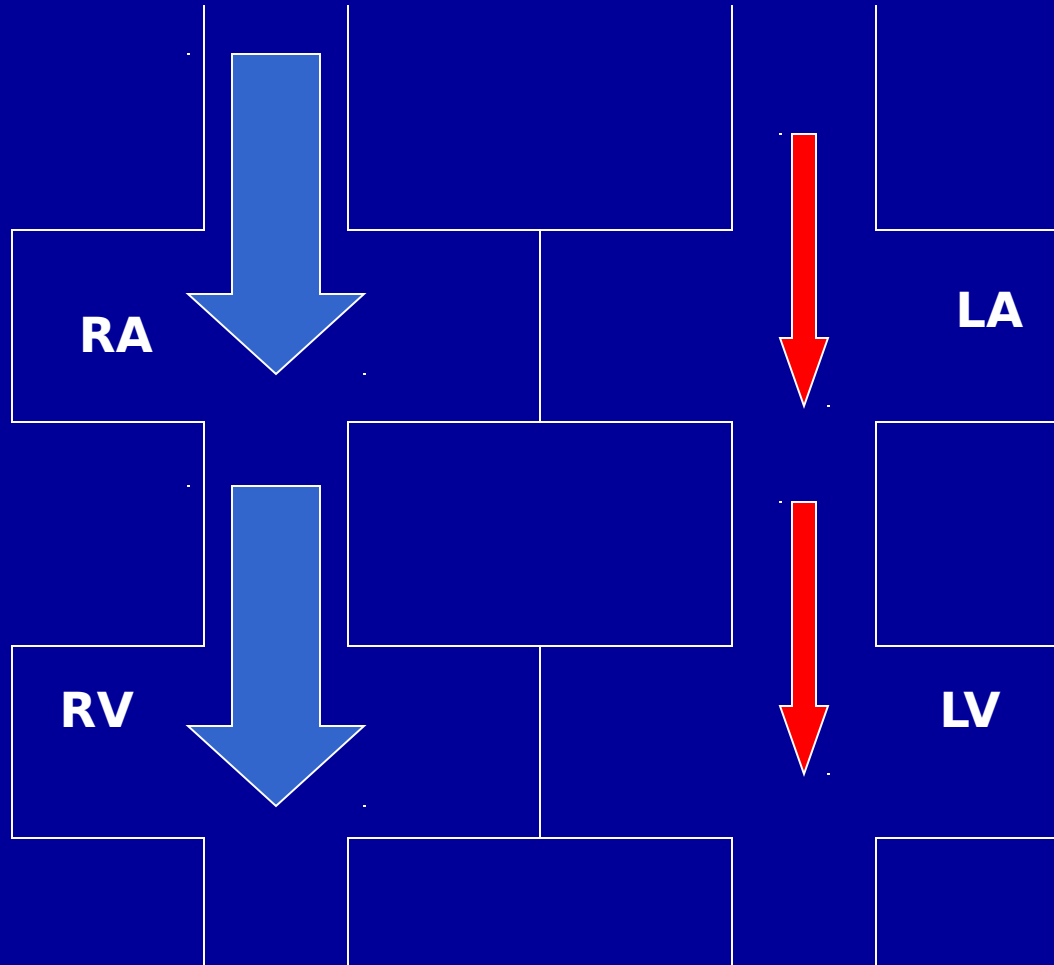
- S2 caused by closure of semilunar valves
- Two distinct components
 - Aortic closure “A2”
 - Pulmonic closure “P2”
 - Time until P2 varies depending on the time it takes the RV to empty
 - If RV is delayed, P2 will be audibly later than A2 causing “splitting”



S2 Splitting

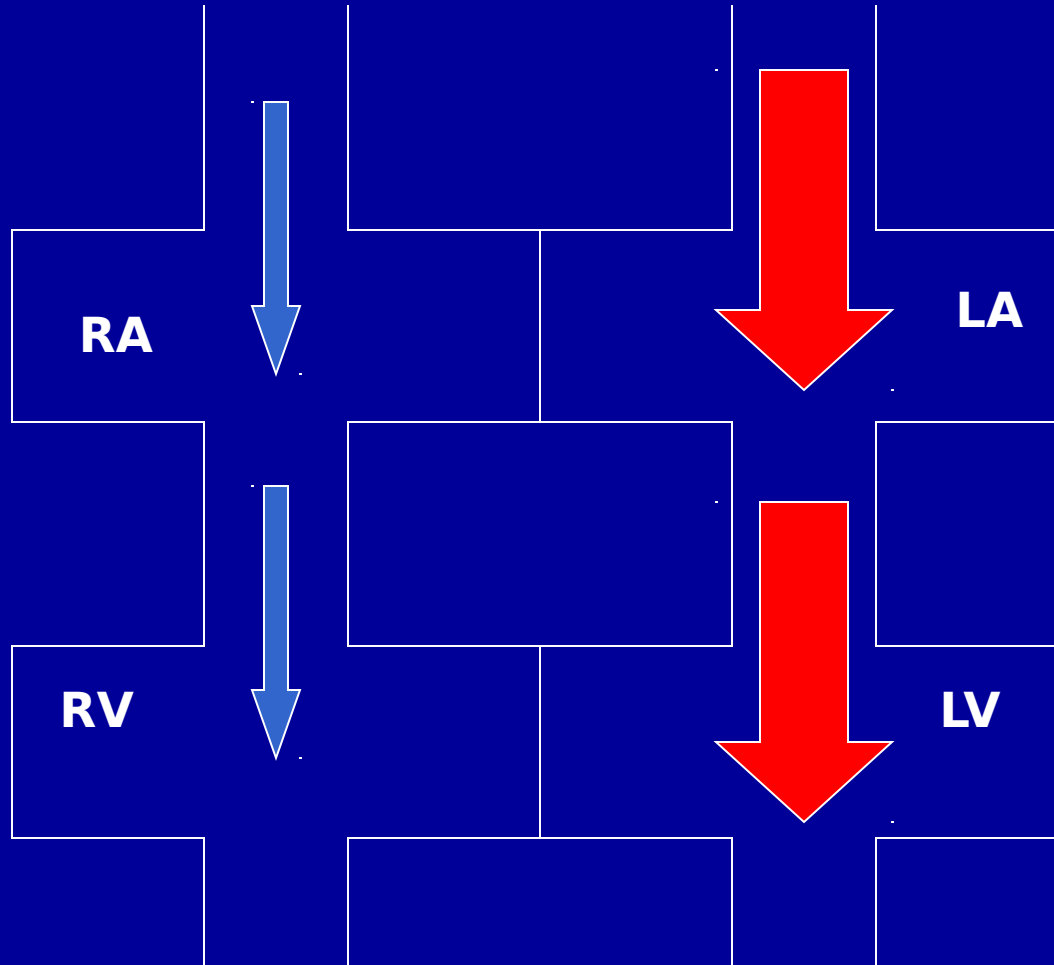
- Inspiration decreases intrathoracic pressure, increases RV filling
- RV is relatively weak, and an increase in filling results in slower emptying
 - Inspiration delays P2, causing audible splitting of S2





Inspiration





Expiration



Abnormalities of S2

- Loud P2
 - If audible at apex, P2 is TOO LOUD
- Single S2
 - A2 or P2 missing
- Wide splitting of S2
- Paradoxical splitting
 - P2 comes after A2 instead of before



Loud P2 means pulmonary hypertension

- SBP in pulmonary artery >35 mm Hg
 - Left heart failure
 - Mitral valve disease
 - Pulmonary arteriolar constriction
 - Pulmonary vessel occlusion
 - Thrombus, tumor, other



Widely split S2

- Late P2
 - Delayed activation of RV
 - Right bundle branch block
 - RV overload
 - Pressure
 - Volume
- Early A2
 - Mitral Regurgitation causing rapid emptying



Pulmonic Stenosis

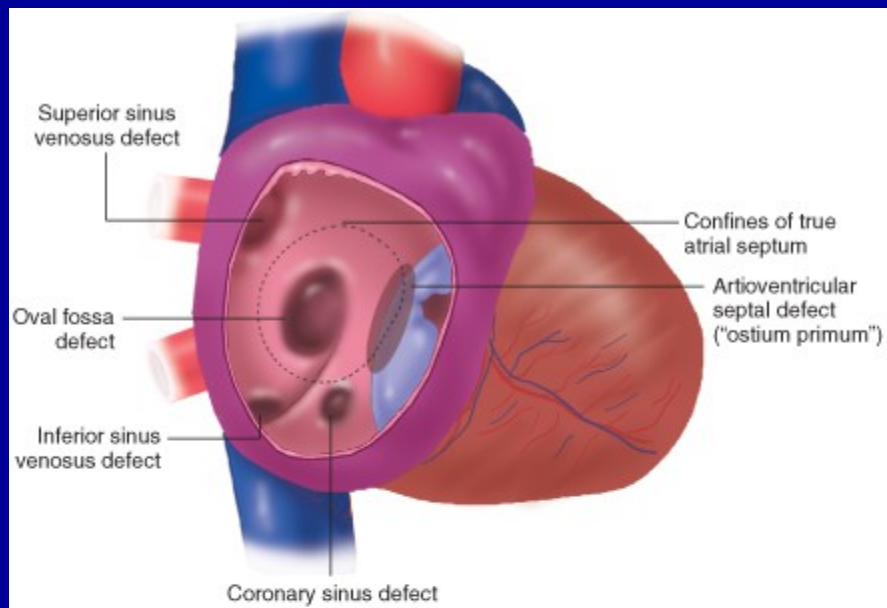
- Obstructs RV emptying
- Pressure overload in RV
- Prolongs RV systole
- Causes widely split S2



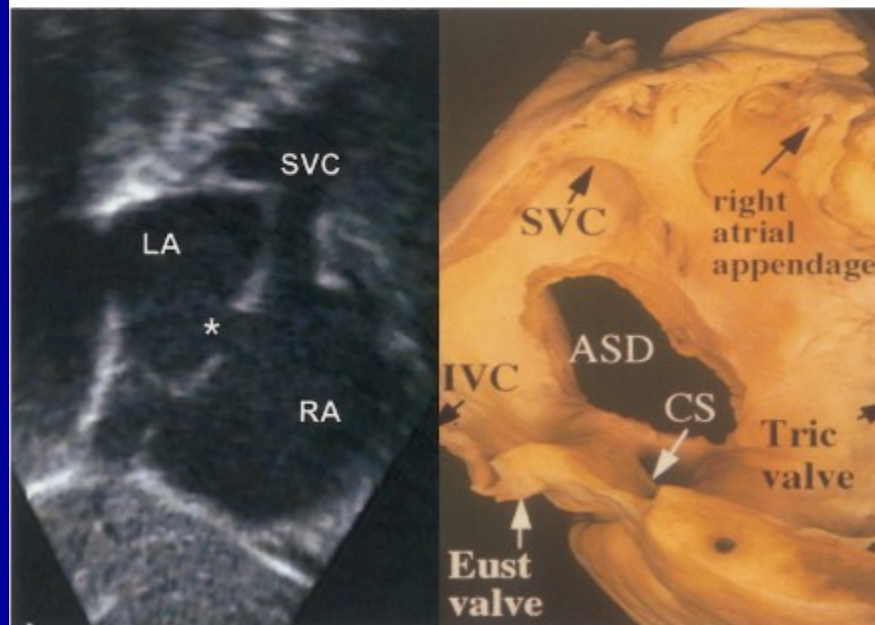
Atrial Septal Defect

- LA blood shunts to RA
- RV volume overload
 - Prolongs RV systole
 - Widely splits S2 due to delay in P2
 - **PERSISTENT, FIXED SPLITTING** of S2
 - Diagnostic of ASD





A

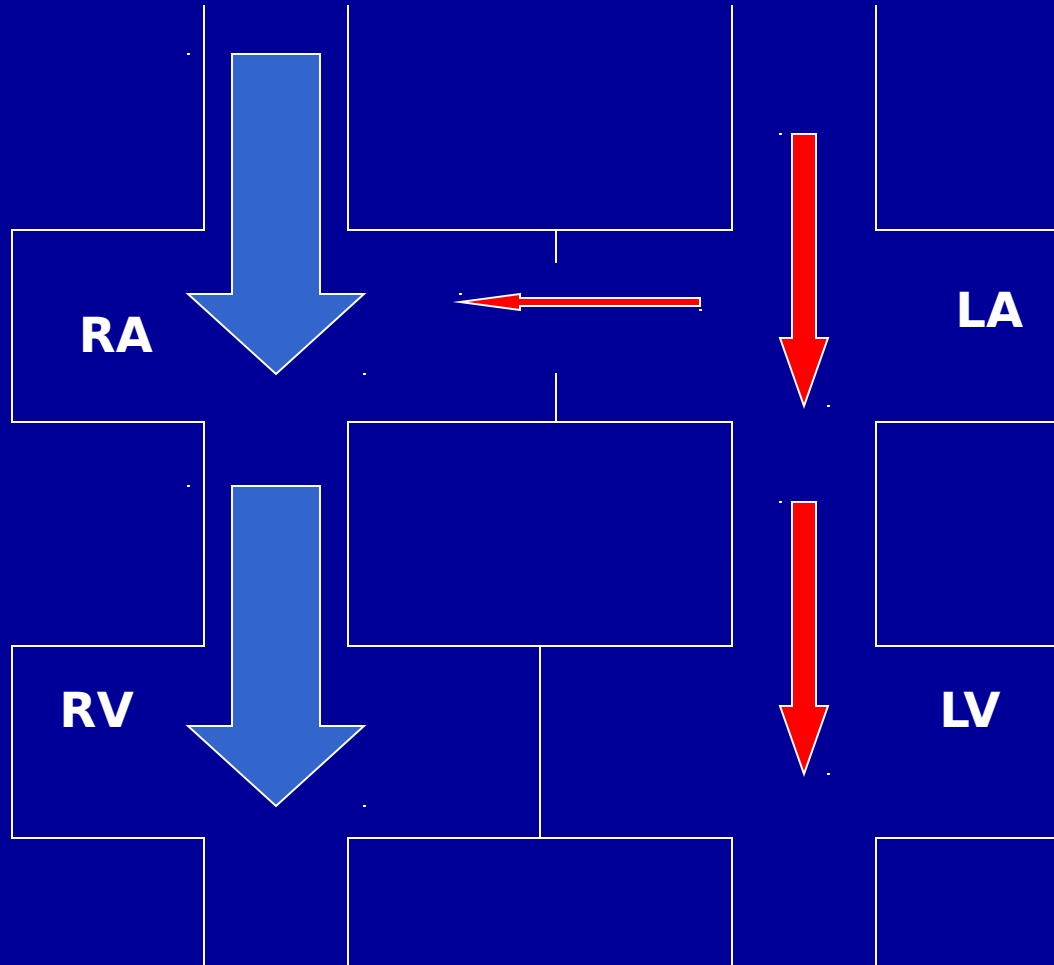


B





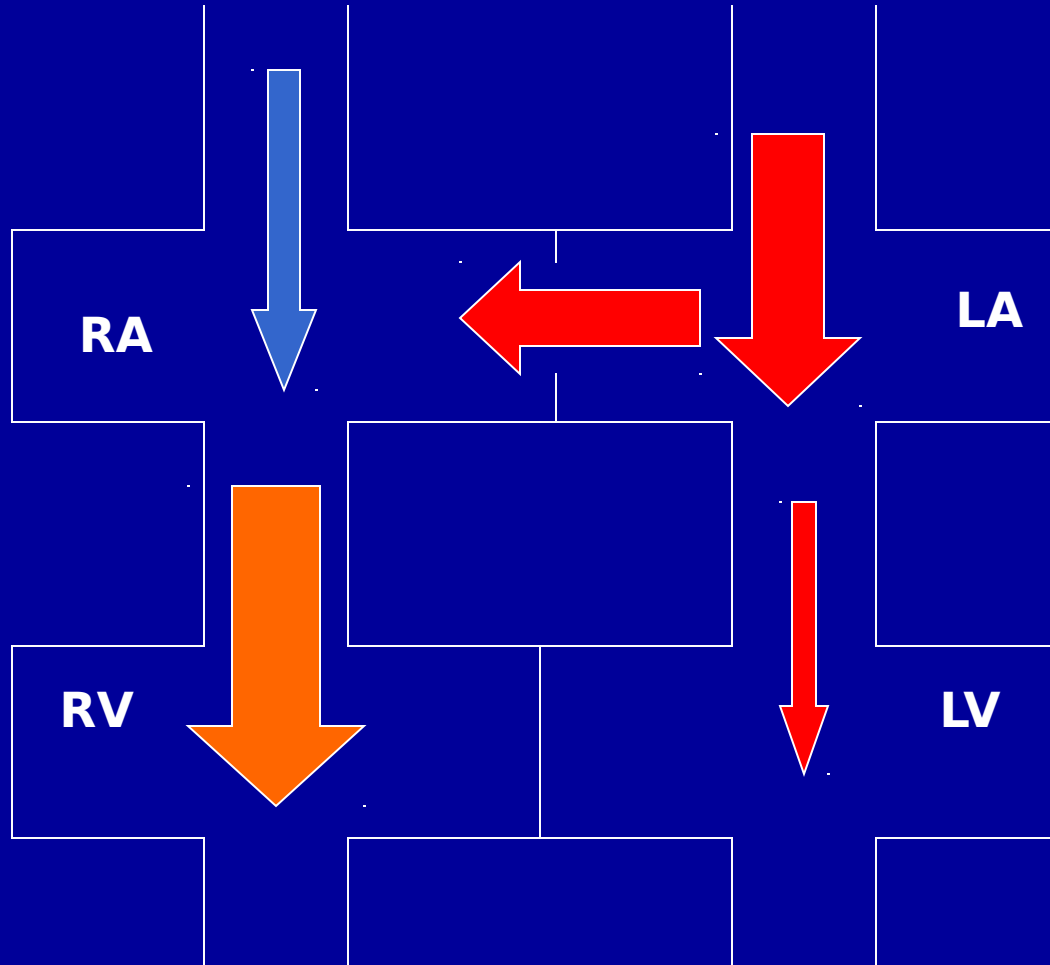
Atrial Septal Defect



Inspiration



Atrial Septal Defect



Expiration



Paradoxical Splitting S2

- A2 is delayed so that it comes after P2
- Split may appear with EXPIRATION, reversing normal pattern
 - Left heart failure
 - Aortic stenosis
 - LBBB
 - PDA
 - Pacemaker



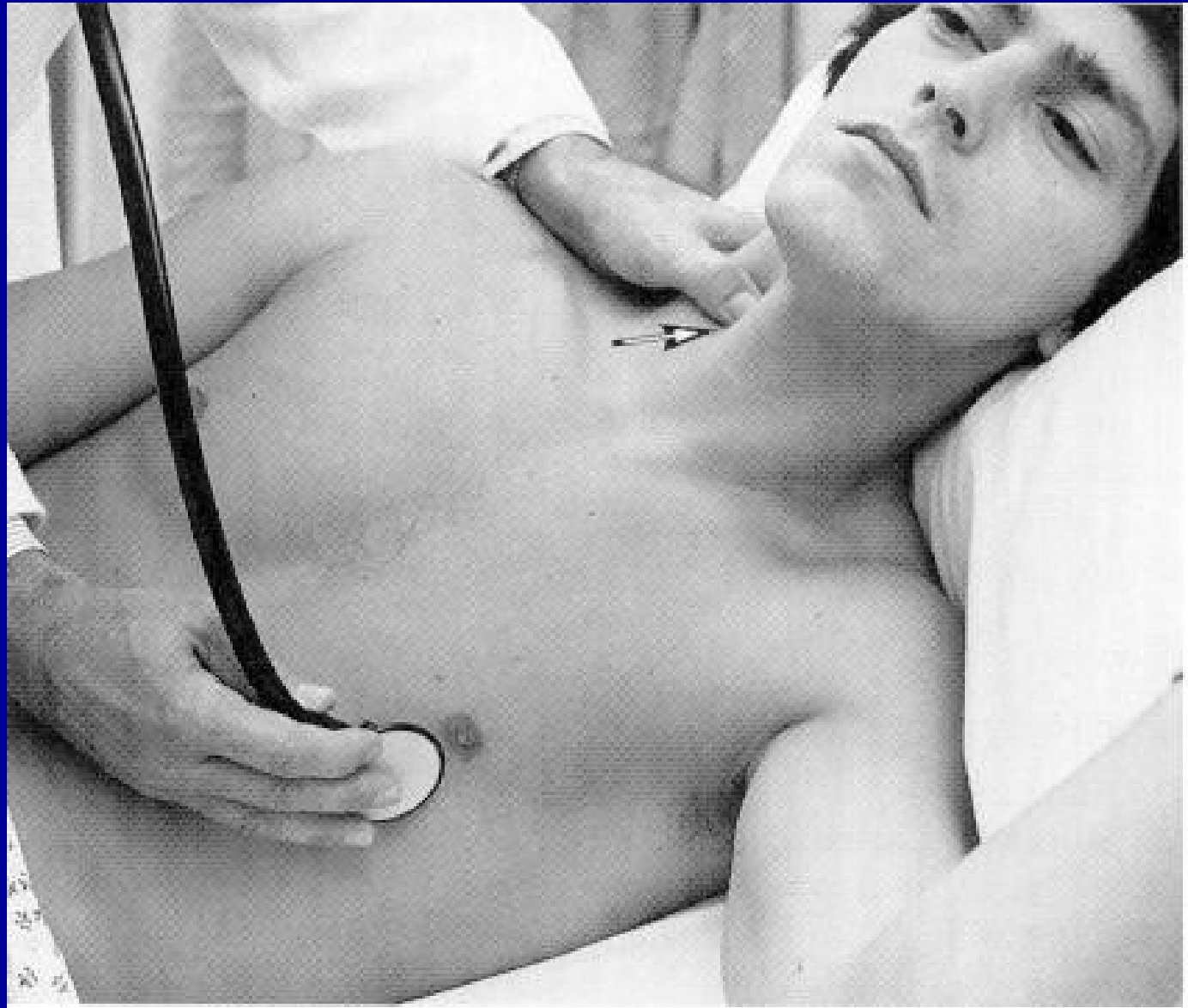


Diastolic filling sounds

- Low frequency sounds caused by filling of ventricles
- DIASTOLIC
- Thud sound
- Difficult to hear
 - Need to listen with BELL, lightly applied to apex in the left lateral decubitus position
 - Cannot hear with diaphragm



Left lateral decubitus



S3

- Follows S2 by 120-160 ms
- Caused by rapid filling phase of diastole
- NORMAL up to 30
 - As heart stiffens with age, disappears
 - In patients with heart disease, typically indicates VOLUME OVERLOAD

| | |
S1 S2 S3





S4

- Precedes S1
- Caused by atrial contraction
 - Blood hitting stiff, noncompliant ventricle
 - Hypertension, Aortic stenosis, LV hypertrophy
- Always abnormal
- Not present in ATRIAL FIBRILLATION

S4 S1 S2



Stupid mnemonics

- S3
 - KEN*TUCK'*Y
 - SHLOSH*ING IN
- S4
 - TEN*NES*SEE'
 - A*STIFF Heart
- S3 and S4
 - Massachusetts





Common Pitfalls

- Split S1
 - High Frequency
 - M1 and T1 intensity similar
 - Located at LLSB, base
- S4, S1
 - Low frequency, S4 only heard with bell
 - S4 subtle, less intense than S1
 - Only heard at apex



Pericardial Knock

- Caused by diastolic filling of a heart with pericardial calcification
 - TB, radiation, pericarditis, idiopathic
 - Timing similar to S3 but LOUD





Ejection sounds

- Opening of aortic or pulmonic valve usually silent
- High frequency sound immediately post S1 usually caused by congenitally abnormal AoV
- May be caused by Aortic or pulmonic dilatation



Short axis views from above aortic valves

Left parasternal long axis view

Aortic arch

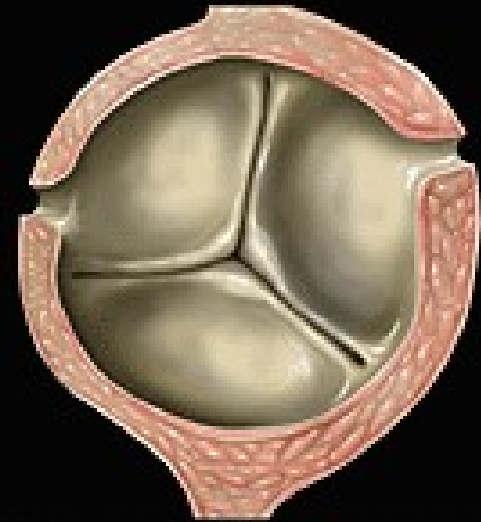
Bicuspid aortic valve

Left atrium

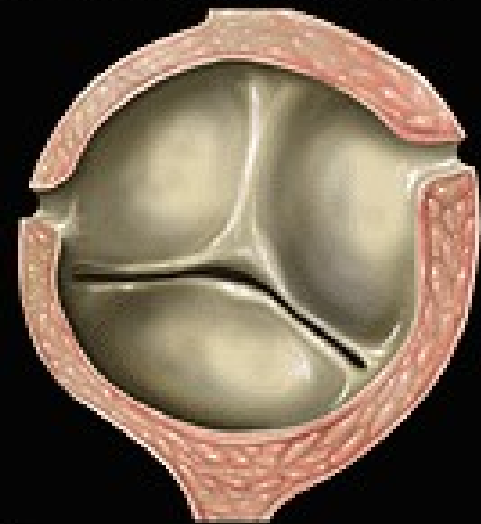
Mitral valve

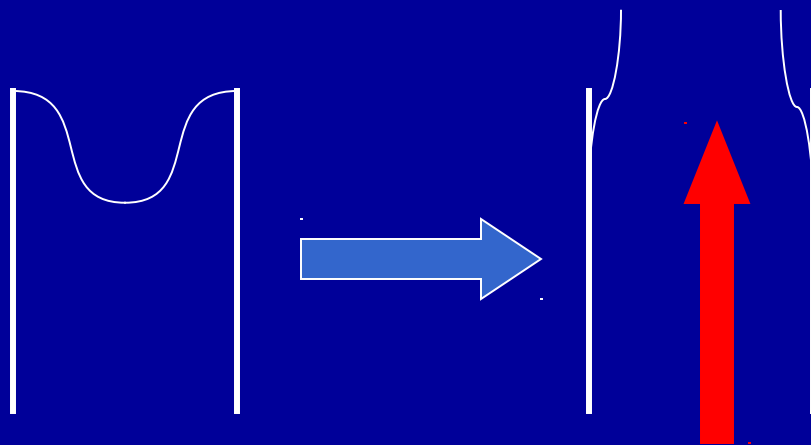
Left ventricle

Normal aortic valve



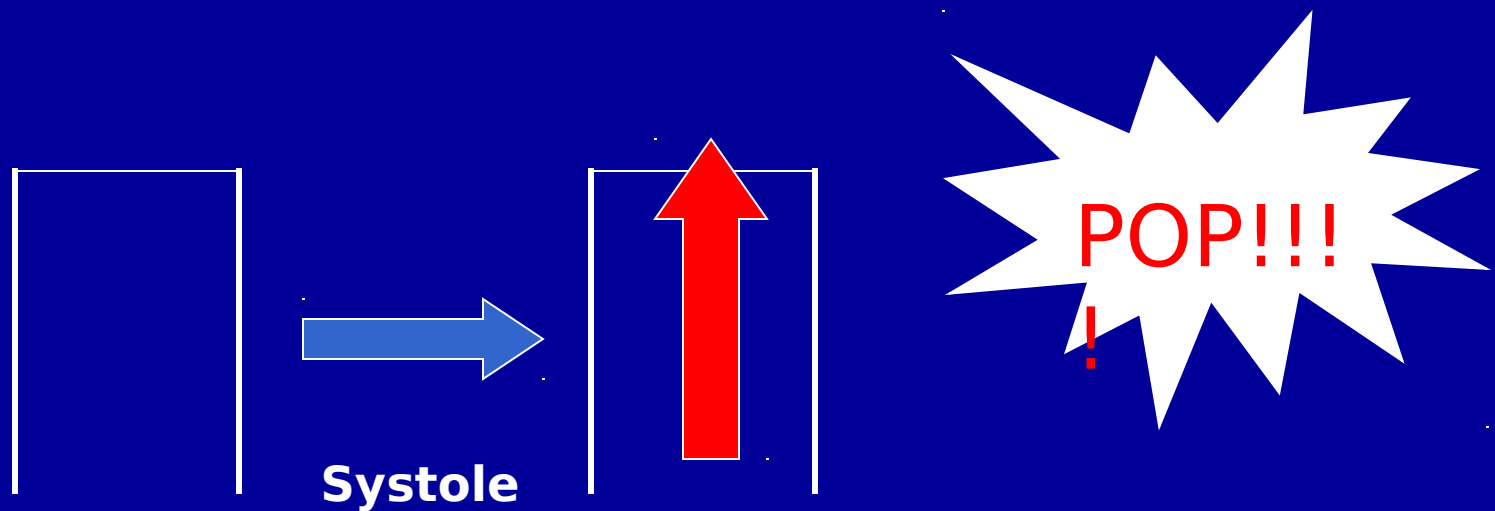
Bicuspid aortic valve





Normal Systole





Abnormal Bicuspid valve resists opening until pressure builds in systole, then causes a loud, high frequency vibration called an ejection sound.



Aortic Ejection Sound

- High Frequency
- No respiratory variation
- Heard over the entire precordium but best at the APEX





Pulmonic ES

- Frequently present in pulmonic stenosis but can also be heard in pulmonary hypertension
- Varies in timing and intensity with respiration
 - May disappear with inspiration



Mitral Opening Snap

- High frequency sound caused by opening of a stiff MV in mitral stenosis
- Well heard with diaphragm
- Frequently heard at the aortic area
- A2-OS interval 30-130 ms, unchanged by respiration

Often the first sign of MS



Mitral Opening Snap

- Closer the interval between A2 and OS, the greater the pressure in the left atrium
 - Suggest more severe mitral stenosis
- Opening snap is often lost in severe mitral stenosis due to calcification





Pitfalls

- Split S2
 - P2 only heard in pulmonic region
 - Should cycle with respiration
 - Short interval (40 ms at end expiration)
- A2, OS
 - OS radiates widely
 - A2-OS interval constant
 - >40 ms

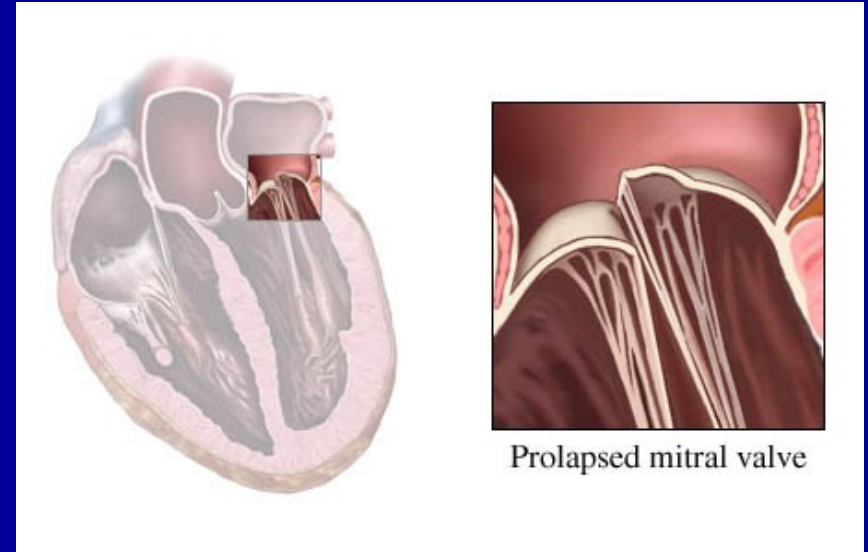
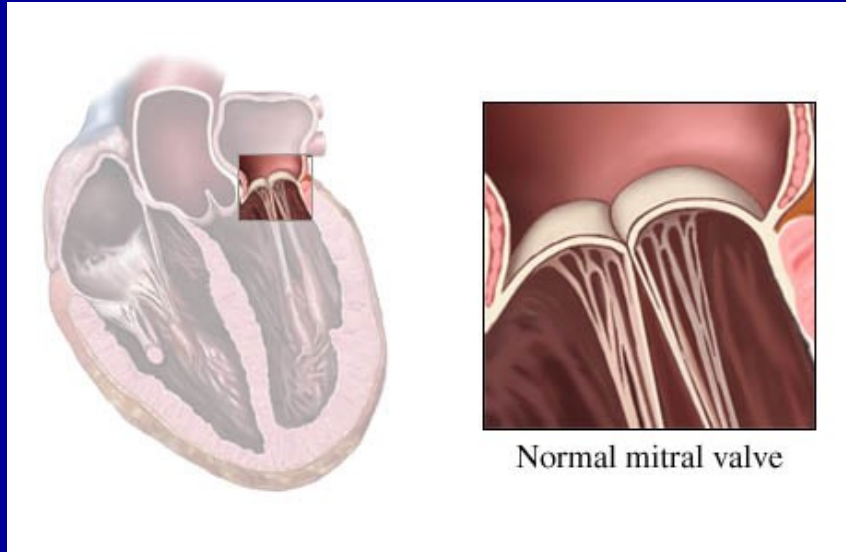


Pitfalls

- S3
 - Low frequency
 - Only heard at apex
- A2, OS
 - High Frequency
 - OS radiates widely



Mitral Valve Prolapse



Movement of mitral leaflet into LA during systole can cause mid systolic “Click” sound

High frequency; heard best at apex
Changes timing with posture

